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Nakayabu

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(54) **SUBSTRATE, CONNECTING STRUCTURE AND ELECTRONIC EQUIPMENT**

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(52) **U.S. Cl.** ..... **361/761**; 361/770; 174/138 G; 174/138 F; 174/254
(58) **Field of Search** ..... 361/760–761, 361/770, 683–686, 752–759; 174/254–255, 138 G, 138 F

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,716,846	A	2/1973	Volckart et al.	340/174 M
4,364,619	A	12/1982	Inayat-Khan	339/17 F
4,858,073	A *	8/1989	Gregory	361/708
5,442,142	A *	8/1995	Hayashi	174/250
5,592,365	A *	1/1997	Sugimoto et al.	361/789
6,459,043	B1 *	10/2002	Dodsworth	174/254
6,531,662	B1 *	3/2003	Nakamura	174/255
2001/0007287	A1	7/2001	Hoche	174/250
2002/0019154	A1	2/2002	Na	439/76.1

FOREIGN PATENT DOCUMENTS

GB	2 331 188 A	5/1999
JP	01140700	6/1989
JP	04290299	10/1992
JP	05037119	2/1993
JP	06224531	8/1994
JP	08228059	9/1996

* cited by examiner

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(57) **ABSTRACT**

A substrate has an electrical wiring pattern formed thereon, one or a plurality of electrical parts provided thereon, a first contacting part and a second contacting part provided thereon and electrically connected to the electronic parts, and one or a plurality of electrical connecting bodies. The electrical connecting bodies are different from the electrical wiring pattern, and electrically connect the first contacting part and the second contacting part.

13 Claims, 10 Drawing Sheets

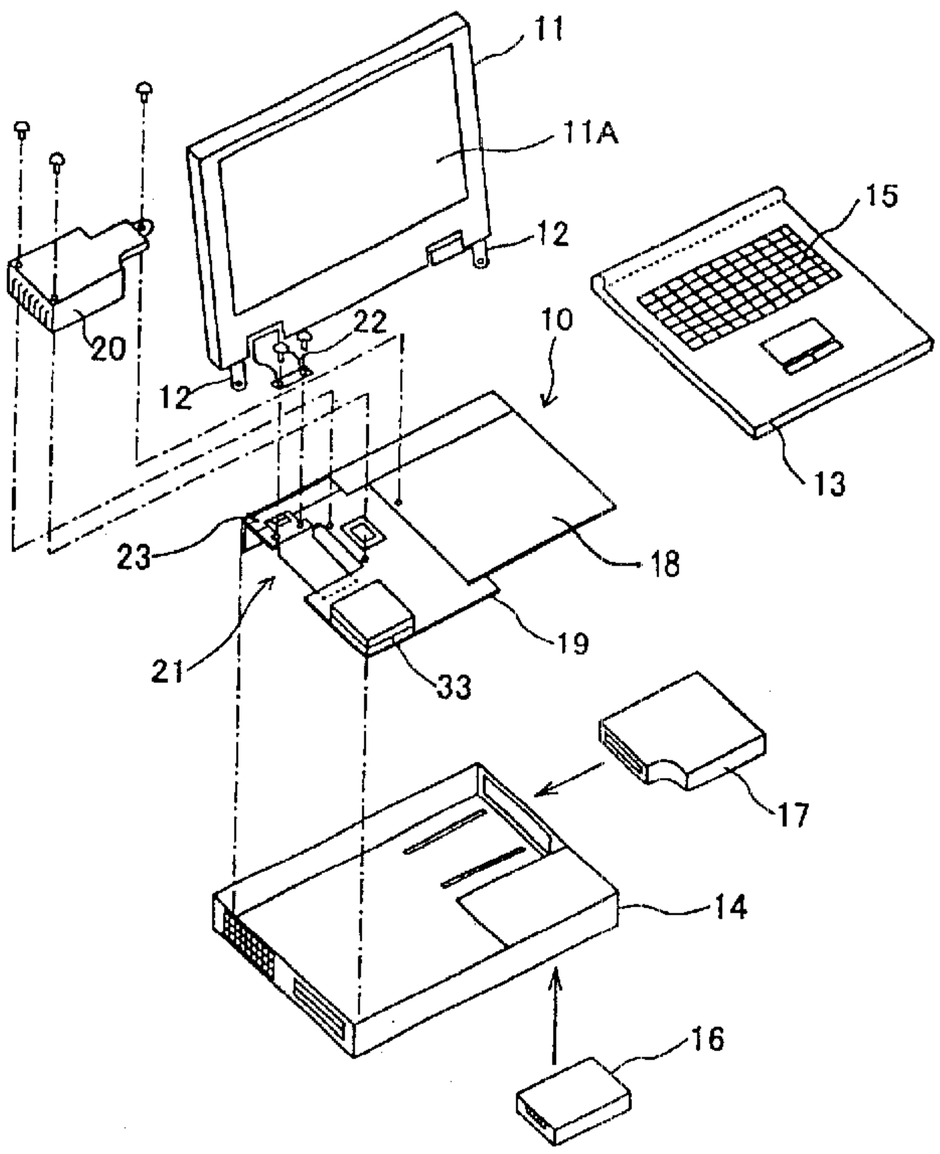


FIG.1

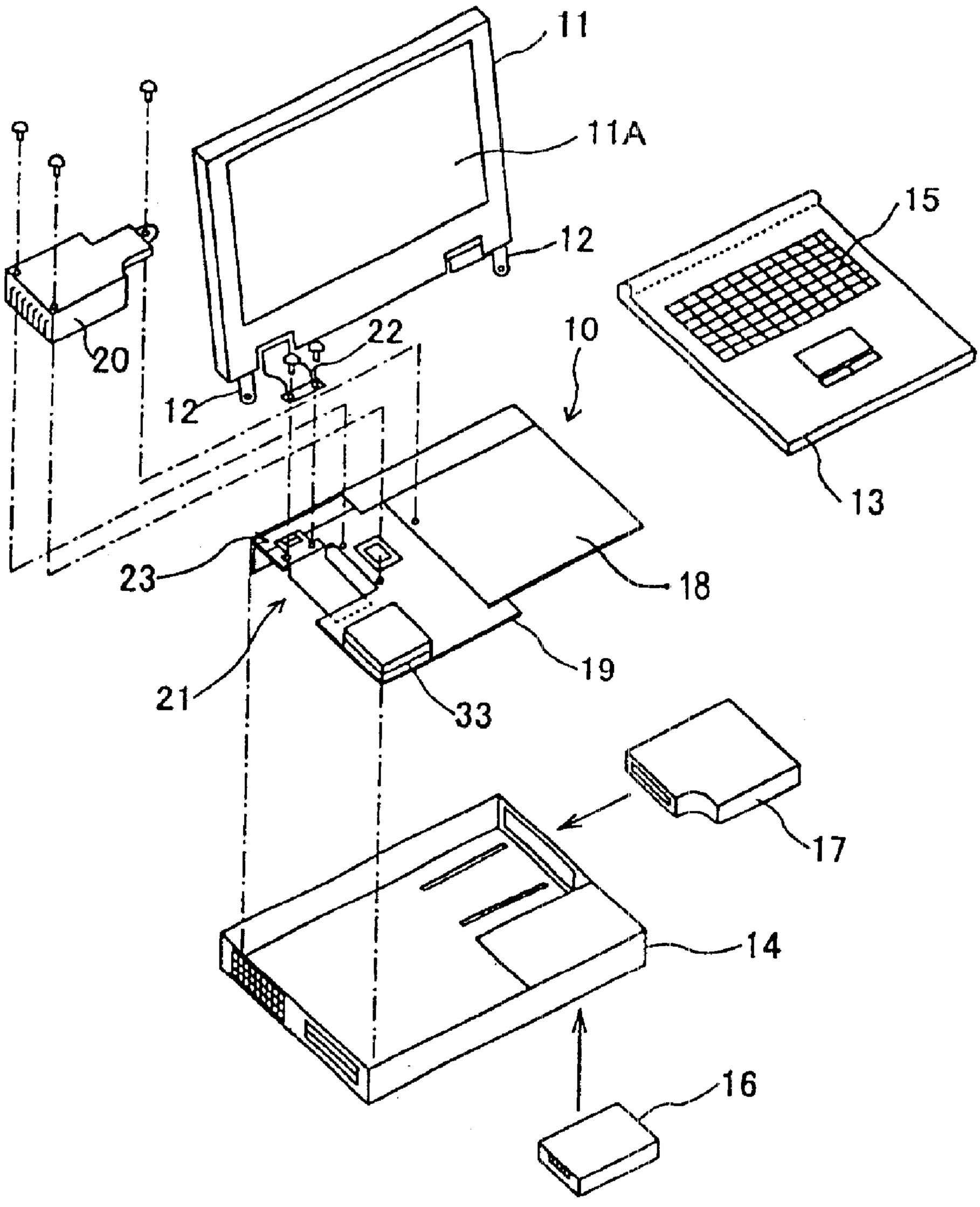


FIG.2

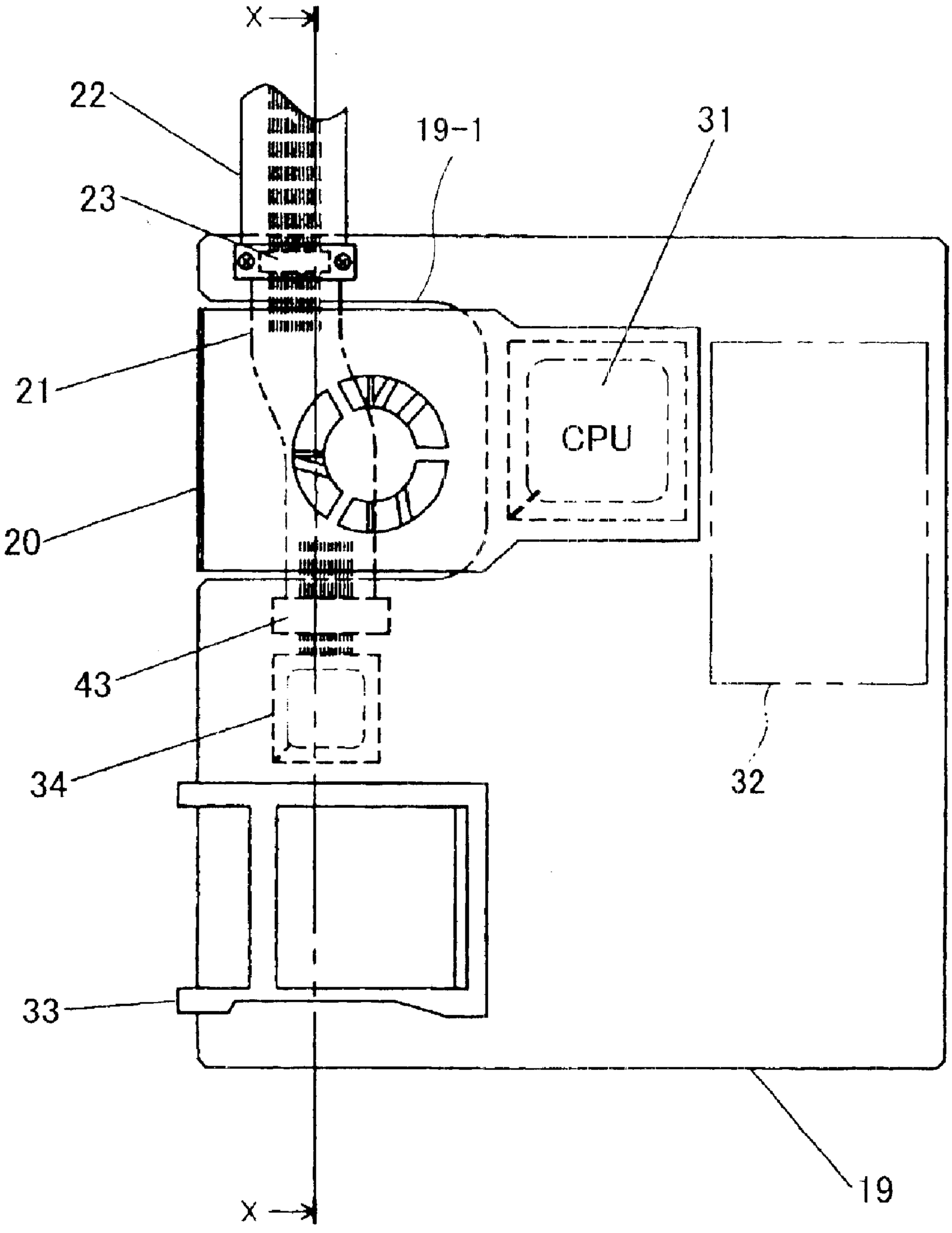


FIG.3

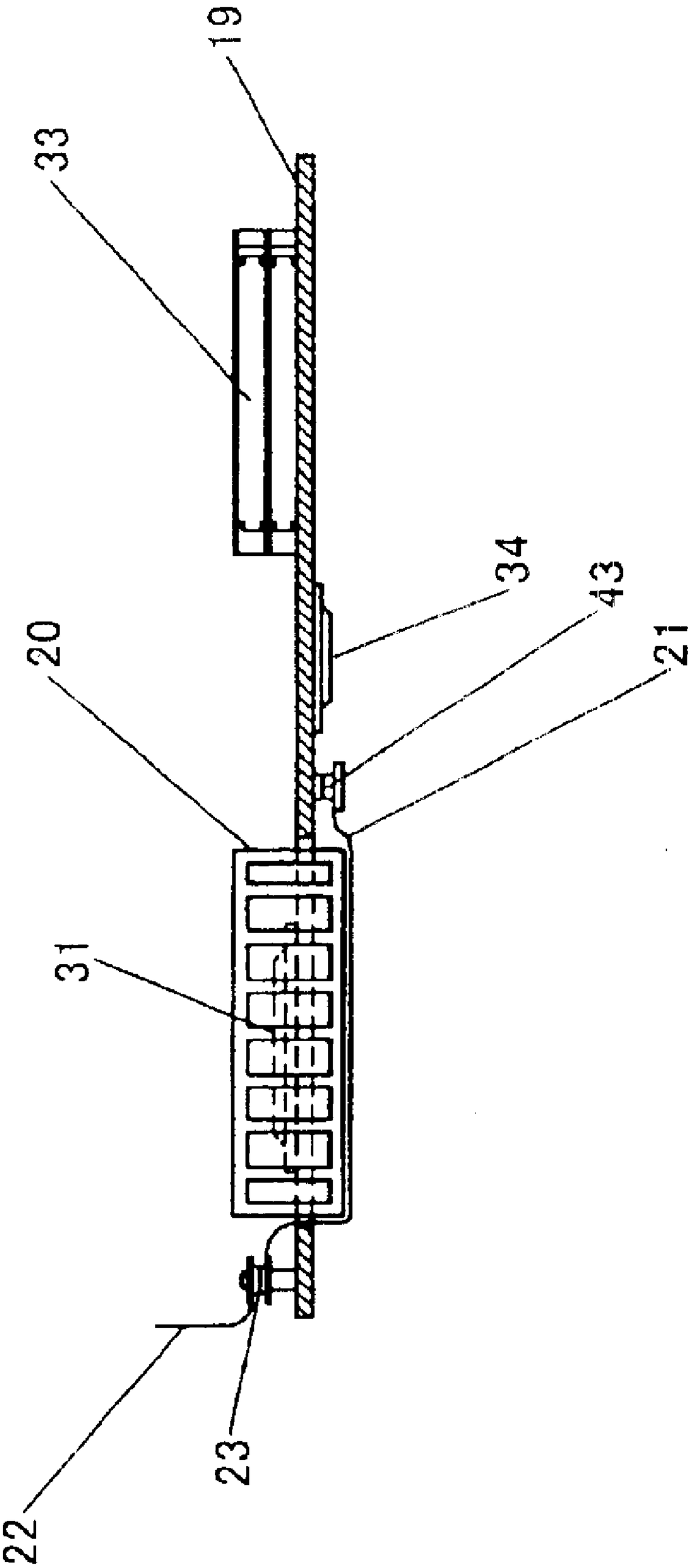


FIG.4

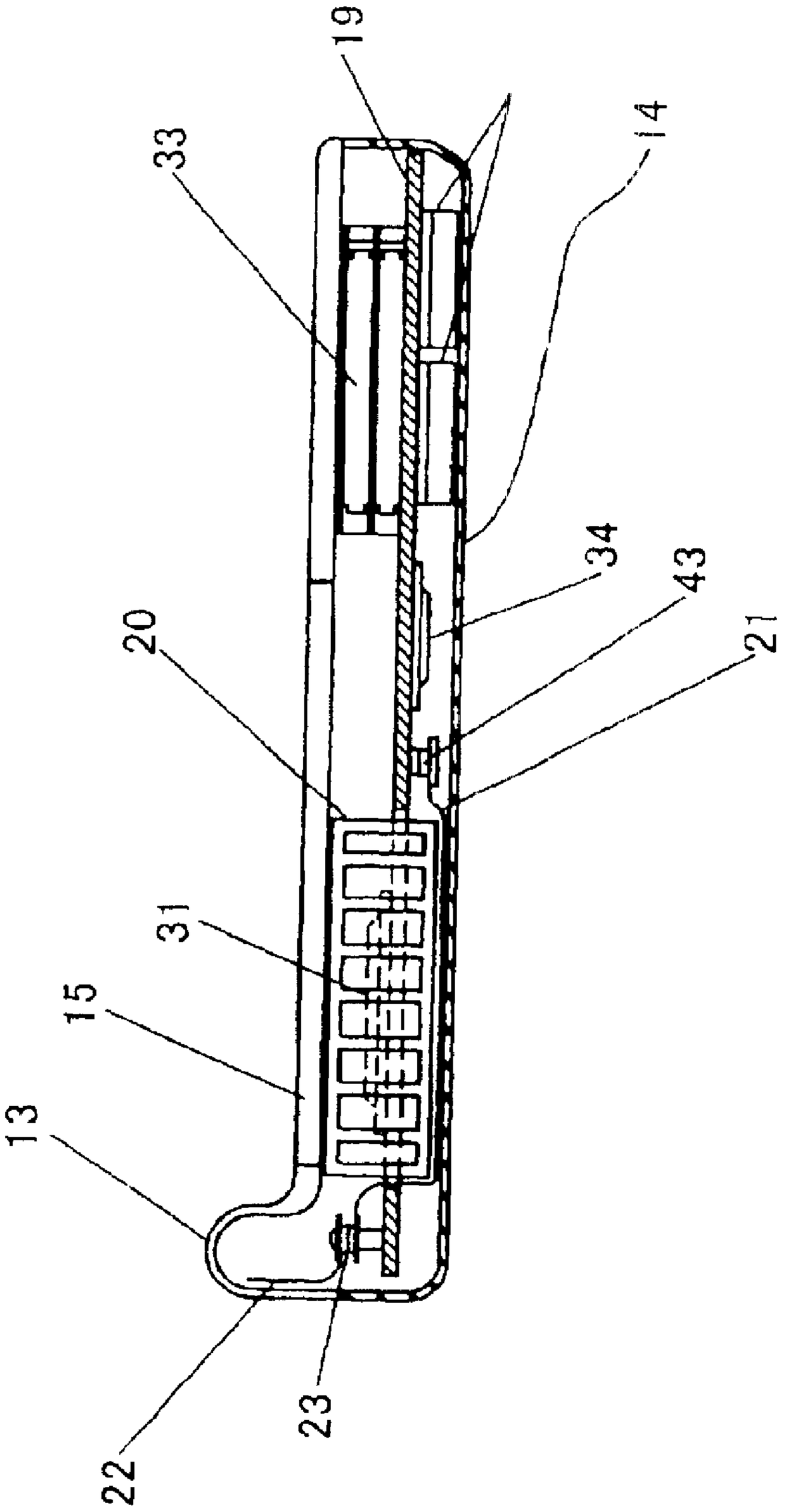


FIG.5

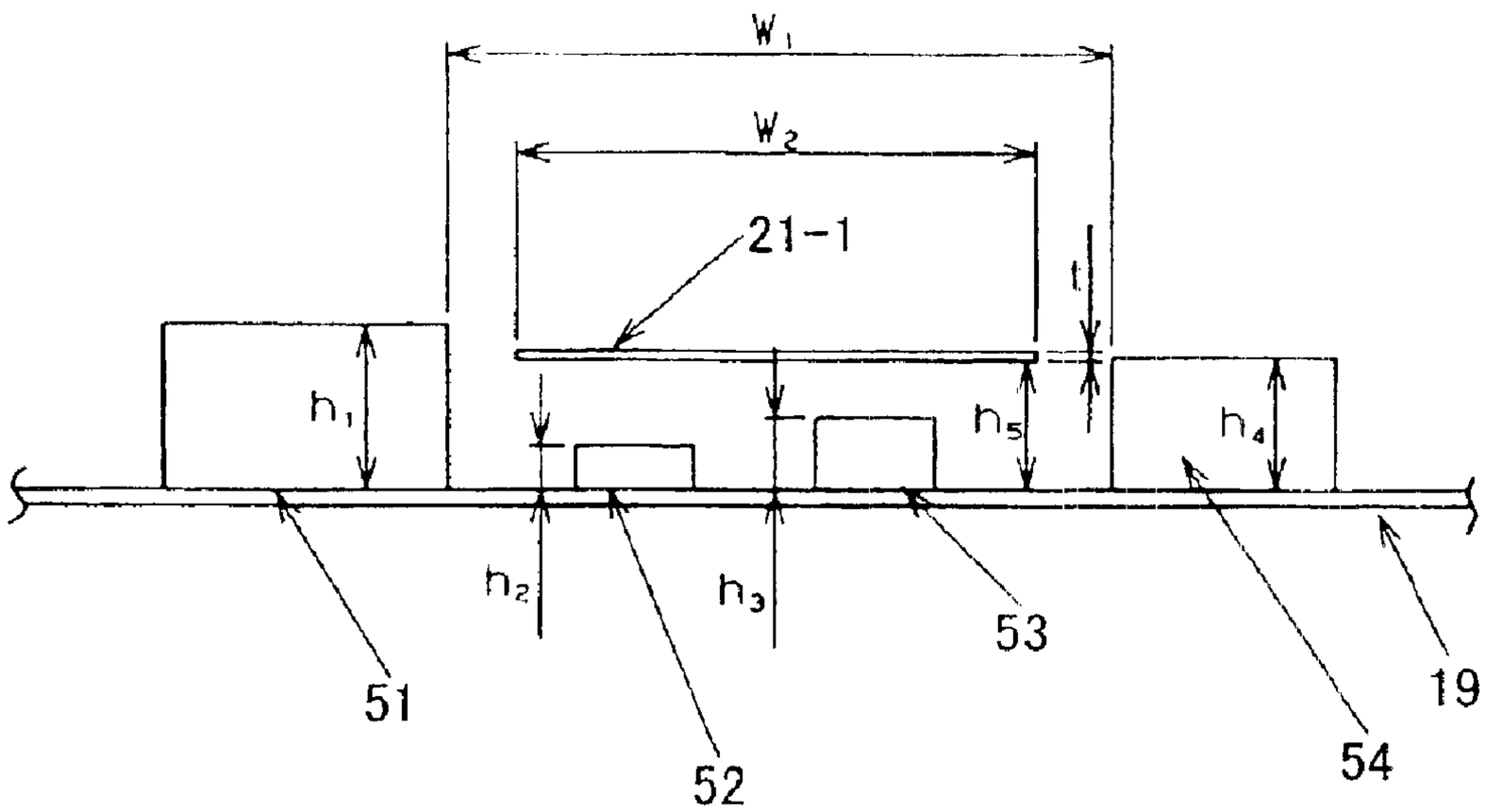


FIG.6A

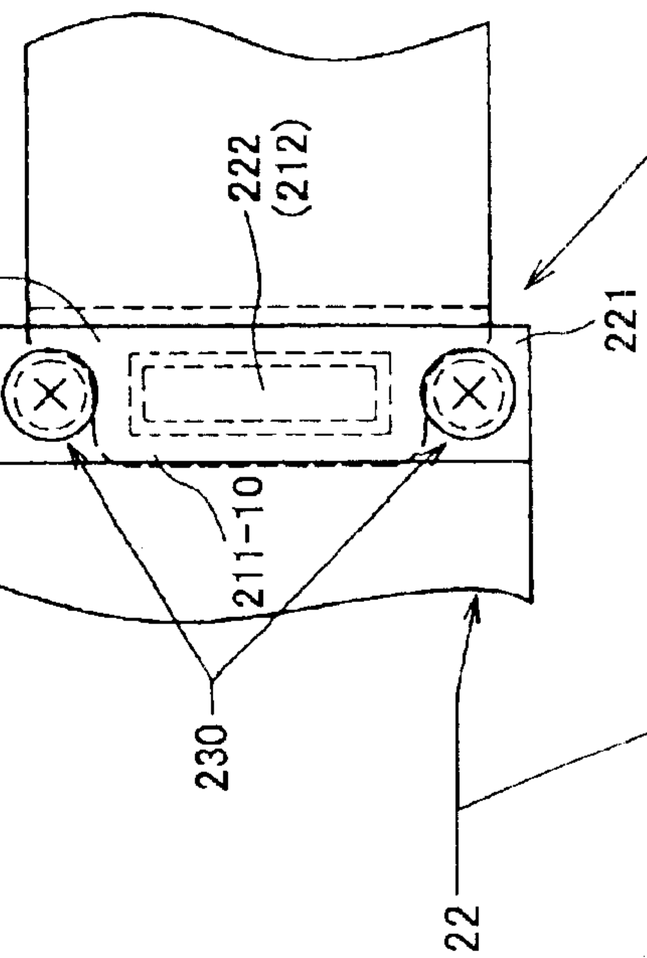


FIG.6C

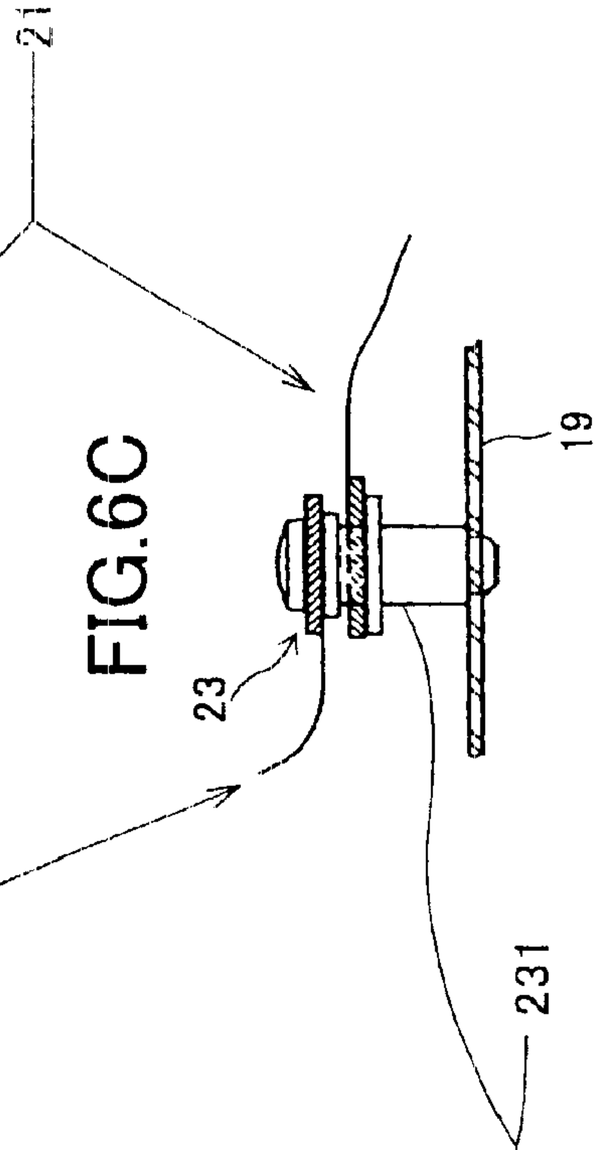


FIG.6B

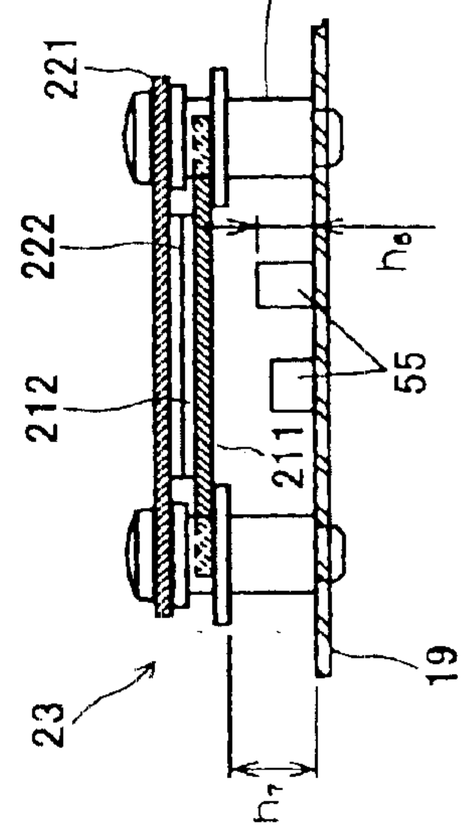


FIG.7A

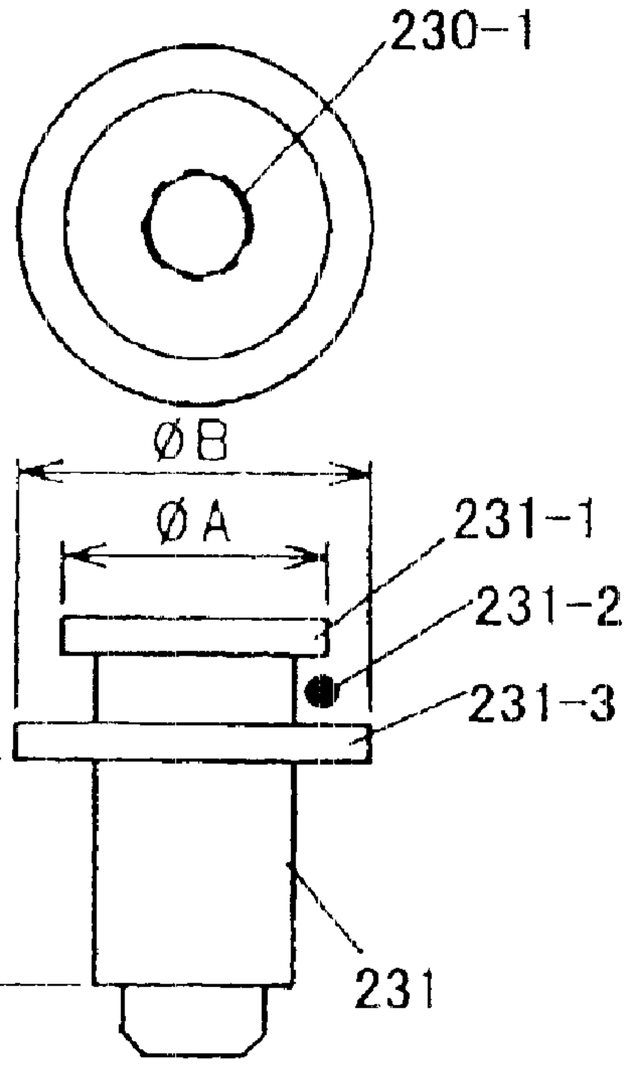


FIG.7B

FIG.8

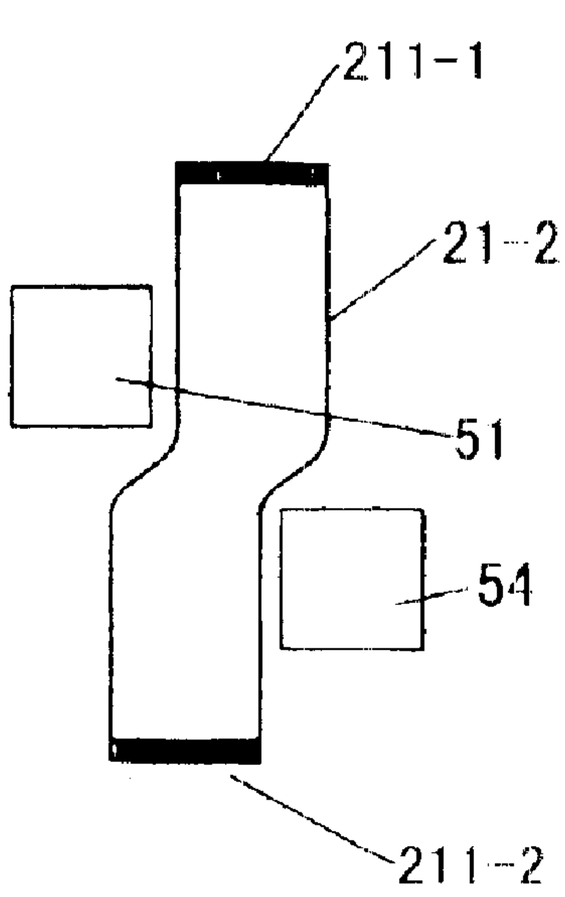


FIG.9

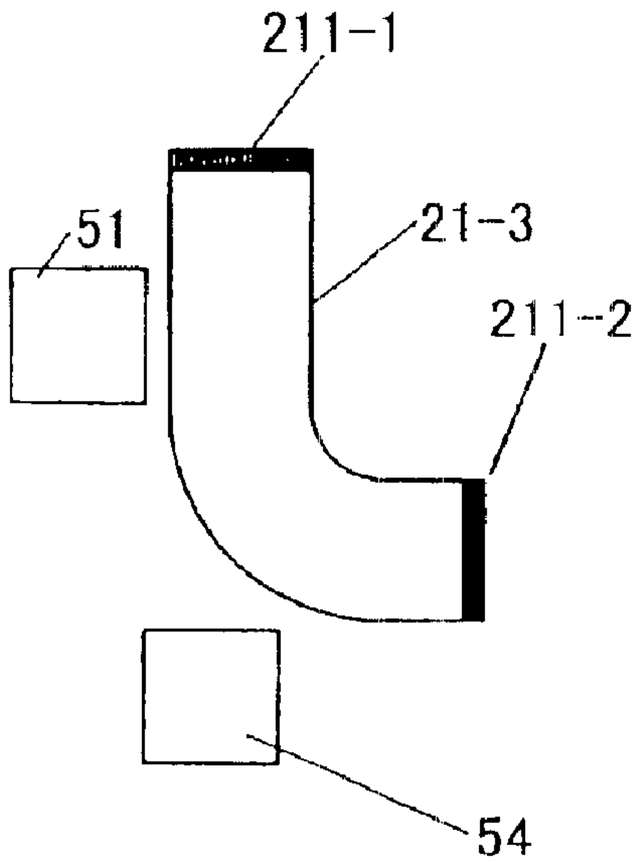


FIG.10

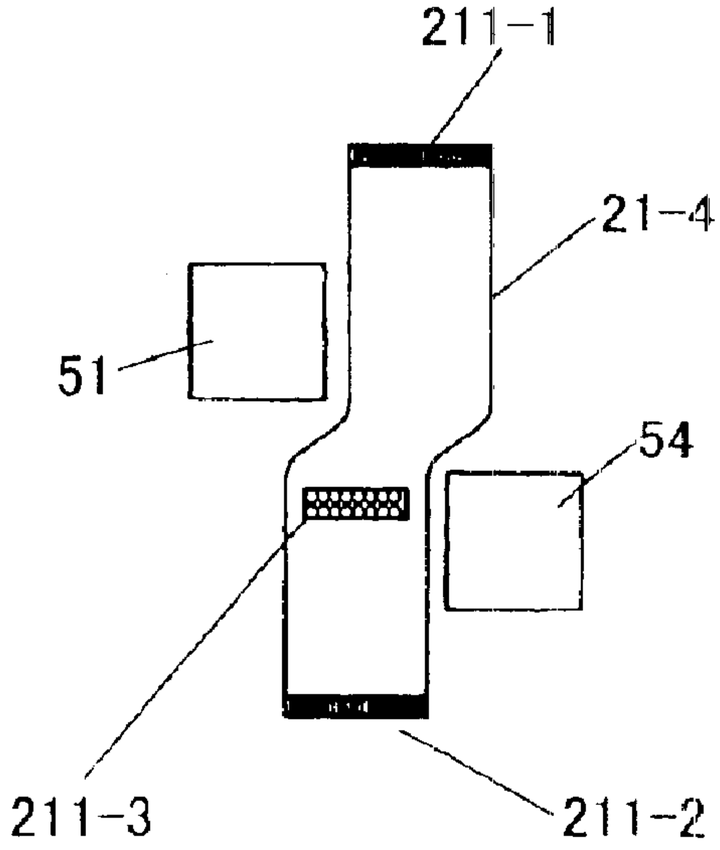


FIG.11

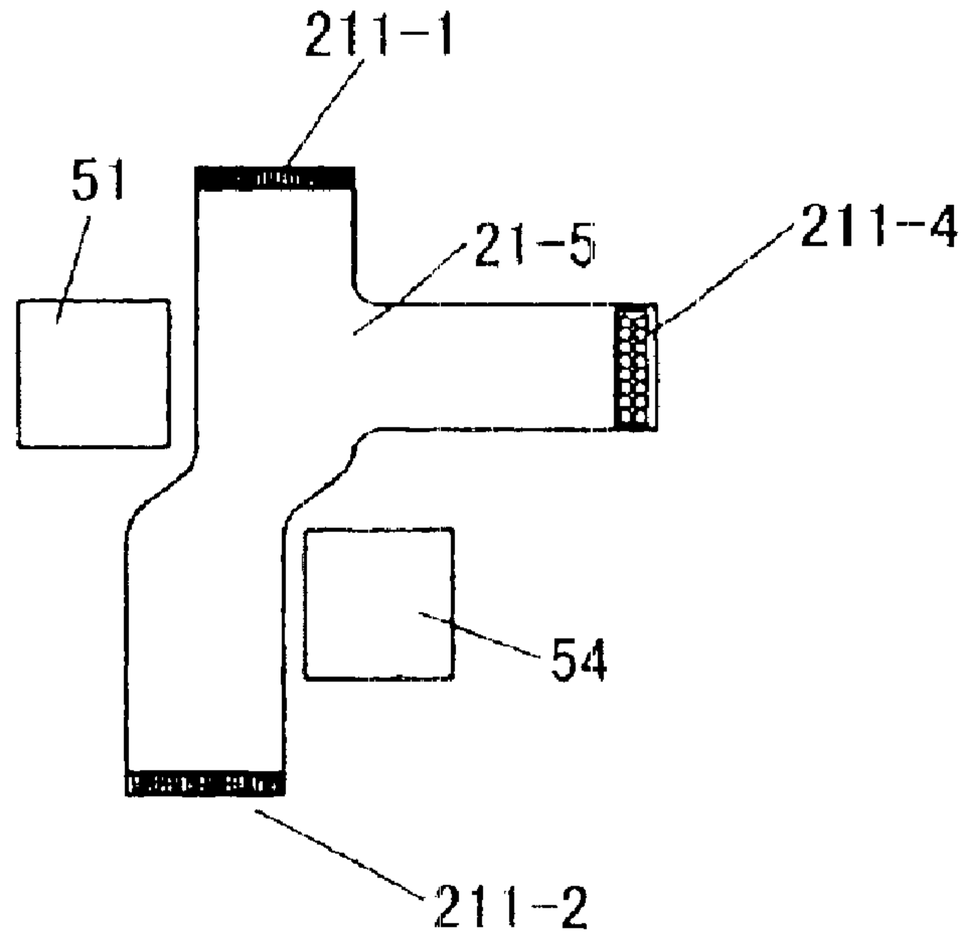


FIG.12

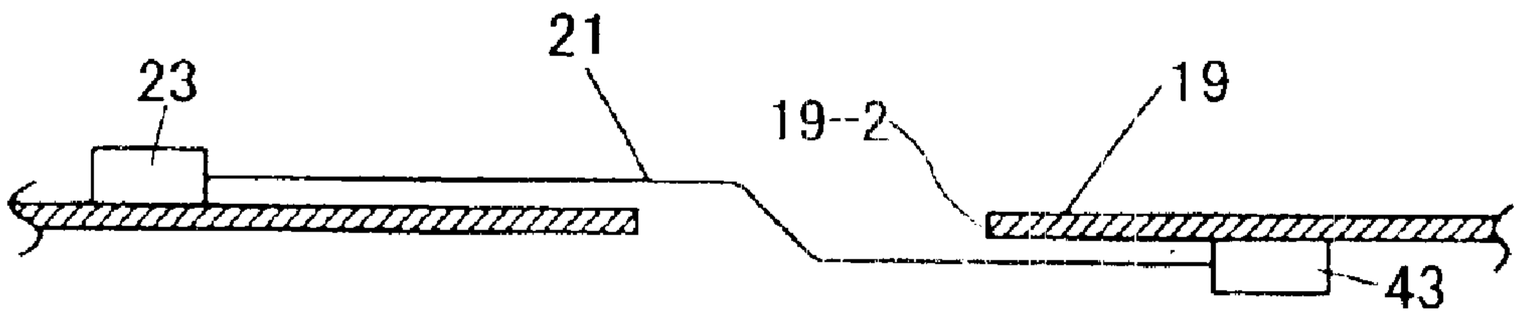
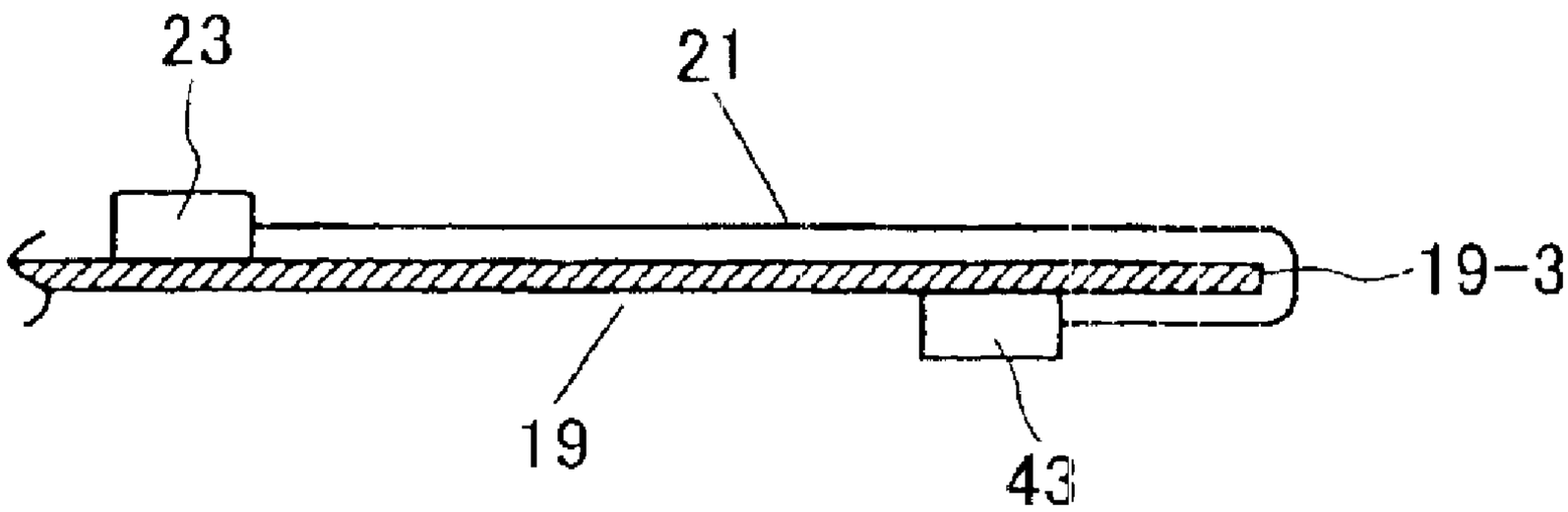


FIG.13



SUBSTRATE, CONNECTING STRUCTURE AND ELECTRONIC EQUIPMENT

BACKGROUND OF THE INVENTION

This application claims the benefit of a Japanese Patent Application No.2002-112247 filed Apr. 15, 2002, in the Japanese Patent Office, the disclosure of which is hereby incorporated by reference.

1. Field of the Invention

The present invention generally relates to substrates, connecting structures and electronic equipments, and more particularly to a substrate which uses an electrical connecting body such as a flexible printed circuit (FPC), a connecting structure which uses an electrical connecting body such as the FPC and is suited for connecting a main body and a lid which opens and closes with respect to the main body, and an electronic equipment having such a substrate or connecting structure.

In this specification, the electronic equipment refers to information processing apparatuses such as a lap-top personal computer, portable telephones and the like which are made up of a main body and a lid which opens and closes with respect to the main body.

2. Description of the Related Art

For example, the lap-top personal computer is made up of the main body and the lid which opens and closes with respect to the main body. A substrate mounted with various parts such as integrated circuit devices (IC chips) is provided within the main body, and a display section made up of a liquid crystal display (LCD) or the like is provided within the lid. Because the lid opens and closes with respect to the main body, the display section and the substrate are electrically connected via the FPC. One end of the FPC is connected to the display section, and the other end of the FPC is connected to a connecting part which is provided at an end portion on the substrate. The connecting part is connected to the electronic parts such as the IC chips on the substrate via a printed wiring formed on the substrate.

The printed wiring on the substrate may be provided on both top and bottom surfaces of the substrate, but the printed wiring must be arranged avoiding positions where the various parts are mounted on the substrate and positions where holes and cutouts are formed in the substrate. Signals supplied to the display section employ the LVDS system or the like, and are high-speed and small-amplitude signals. Hence, the substrate must satisfy various layout and wiring conditions, such as limited wiring length and wiring layout for preventing mixture of external noise. Accordingly, depending on the layout and wiring conditions, it is necessary to take measures such as arranging the IC chip for driving the display section in a vicinity of the connecting part on the substrate, and arranging the printed wiring on the substrate at a position separated from other printed wiring for the high-speed signals.

Recently, due to increased operation speeds of internal circuits of the CPU or the like, heat generated from the IC chips mounted on the substrate has become large. For this reason, it has become necessary to provide holes and cutouts in the substrate, and to provide radiator parts or heat sinks at the holes and cutouts so as to improve the heat radiation or heat release from the IC chips. In order to improve the heat radiation, the radiator parts must be made large, which means that the corresponding holes and cutouts in the substrate must also be made large. The printed wiring on the substrate must be arranged avoiding these holes, cutouts and radiator parts.

On the other hand, in order to meet the demands to further reduce the size of the lap-top personal computer, gaps or spacings between the parts mounted on the substrate are becoming smaller. As a result, the degree of freedom of wiring is decreasing for the printed wiring on the substrate.

It is conceivable to provide a multi-layer (or multi-level) wiring structure on the substrate, but the structure of the substrate will become complex. In addition, as the multi-layer wiring structure itself and the connections of the various wiring layers and the electronic parts such as the IC chips become more complex, the assembling process becomes complex, to thereby increase both the production cost of the substrate and the thickness of the substrate. Hence, it is difficult to realize a thin lap-top personal computer using the substrate having the multi-layer wiring structure.

Therefore, in the conventional electronic equipment, there are problems in that it is difficult to conform to the various restrictions with respect to the printed wiring on the substrate, secure a relatively large degree of freedom of wiring, and electrically connect a portion on the substrate and another portion, while simultaneously meeting the demands to reduce both the cost and size of the electronic equipment.

SUMMARY OF THE INVENTION

Accordingly, it is a general object of the present invention to provide a novel and useful substrate, connecting structure and electronic equipment, in which the problems described above are eliminated.

Another and more specific object of the present invention is to provide a substrate, a connecting structure and an electronic equipment which can conform to the various restrictions with respect to the printed wiring on the substrate, secure a relatively large degree of freedom of wiring, and electrically connect a portion on the substrate and another portion, while simultaneously meeting the demands to reduce both the cost and size of the electronic equipment.

Still another object of the present invention is to provide a substrate comprising an electrical wiring pattern formed on the substrate; one or a plurality of electrical parts provided on the substrate; a first contacting part and a second contacting part provided on the substrate and electrically connected to the electronic parts; and one or a plurality of electrical connecting bodies, different from the electrical wiring pattern, electrically connecting the first contacting part and the second contacting part. According to the substrate of the present invention, it is possible to conform to the various restrictions with respect to the printed wiring on the substrate, secure a relatively large degree of freedom of wiring, and electrically connect a portion on the substrate and another portion, while simultaneously meeting the demands to reduce both the cost and size of the electronic equipment.

A further object of the present invention is to provide a substrate comprising an electrical wiring pattern formed on the substrate; one or a plurality of electrical parts provided on the substrate; and a first contacting part and a second contacting part provided on the substrate and electrically connected to the electronic parts, wherein the first contacting part and the second contacting part are electrically connected via one or a plurality of electrical connecting bodies which are different from the electrical wiring pattern. According to the substrate of the present invention, it is possible to conform to the various restrictions with respect

to the printed wiring on the substrate, secure a relatively large degree of freedom of wiring, and electrically connect a portion on the substrate and another portion, while simultaneously meeting the demands to reduce both the cost and size of the electronic equipment.

Another object of the present invention is to provide a connecting structure for connecting a first electrical connecting body and a second electrical connecting body, the first electrical connecting body having a first contacting part electrically connected to one or a plurality of electronic parts provided on a first surface of a substrate and a second contacting part, the second electrical connecting body having a first contacting part electrically connected externally to the substrate and a second contacting part, comprising a connecting part, provided on the substrate, electrically connecting the second contacting part of the first electrical connecting body and the second contacting part of the second electrical connecting body at a height position separated by a predetermined distance from the first surface of the substrate. According to the connecting structure of the present invention, it is possible to conform to the various restrictions with respect to the printed wiring on the substrate, secure a relatively large degree of freedom of wiring, and electrically connect a portion on the substrate and another portion, while simultaneously meeting the demands to reduce both the cost and size of the electronic equipment.

Still another object of the present invention is to provide an electronic equipment comprising a substrate having an electrical wiring pattern formed thereon; a first contacting part provided on the substrate and electrically connected to one or more electronic parts provided on the substrate; a second contacting part provided on the substrate; and an electrical connecting body, different from the electrical wiring pattern, electrically connecting the first contacting part and the second contacting part. According to the electronic equipment of the present invention, it is possible to conform to the various restrictions with respect to the printed wiring on the substrate, secure a relatively large degree of freedom of wiring, and electrically connect a portion on the substrate and another portion, while simultaneously meeting the demands to reduce both the cost and size of the electronic equipment.

Another object of the present invention is to provide an electronic equipment comprising a substrate having an electrical wiring pattern formed thereon; a first contacting part provided on the substrate and electrically connected to one or more electronic parts provided on the substrate; and a second contacting part provided on the substrate, where the first contacting part and the second contacting part are electrically connected by an electrical connecting body which is different from the electrical wiring pattern. According to the electronic equipment of the present invention, it is possible to conform to the various restrictions with respect to the printed wiring on the substrate, secure a relatively large degree of freedom of wiring, and electrically connect a portion on the substrate and another portion, while simultaneously meeting the demands to reduce both the cost and size of the electronic equipment.

A further object of the present invention is to provide an electronic equipment comprising a main body internally having a substrate and a first electrical connecting body, the first electrical connecting body having a first contacting part electrically connected to one or more electronic parts provided on a first surface of the substrate and a second contacting part; a lid which opens and closes with respect to the main body; a second electrical connecting body electrically connecting the lid and the substrate, the second electrical connecting body having a first contacting part electrically connected to the lid and a second contacting part; and a connecting part, provided on the substrate, electrically connecting the second contacting part of the first electrical connecting body and the second contacting part of the second electrical connecting body at a height position separated by a predetermined distance from the first surface of the substrate. According to the electronic equipment of the present invention, it is possible to conform to the various restrictions with respect to the printed wiring on the substrate, secure a relatively large degree of freedom of wiring, and electrically connect a portion on the substrate and another portion, while simultaneously meeting the demands to reduce both the cost and size of the electronic equipment.

Other objects and further features of the present invention will be apparent from the following detailed description when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a disassembled perspective view showing an embodiment of an electronic equipment according to the present invention;

FIG. **2** is a plan view showing a substrate of the embodiment of the electronic equipment;

FIG. **3** is a cross sectional view showing the substrate cut along a line X—X in FIG. **2**;

FIG. **4** is a side view showing the embodiment of the electronic equipment viewed from the left side;

FIG. **5** is a diagram for explaining positional relationships of heights of parts on the substrate and a FPC;

FIGS. **6**A, **6**B and **6**C are diagrams showing the structure of a connecting part;

FIGS. **7**A and **7**B are diagrams for explaining a screw portion of the connecting part;

FIG. **8** is a diagram for explaining a first embodiment of the FPC;

FIG. **9** is a diagram for explaining a second embodiment of the FPC;

FIG. **10** is a diagram for explaining a third embodiment of the FPC;

FIG. **11** is a diagram for explaining a fourth embodiment of the FPC;

FIG. **12** is a diagram for explaining a connection state of the FPC; and

FIG. **13** is a diagram for explaining another connection state of the FPC.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A description will be given of various embodiments of a substrate, a connecting structure and an electronic equipment according to the present invention, by referring to the drawings.

FIG. **1** is a disassembled perspective view showing an embodiment of the electronic equipment according to the present invention. FIG. **2** is a plan view showing a substrate of this embodiment of the electronic equipment. FIG. **3** is a cross sectional view showing the substrate cut along a line X—X in FIG. **2**. FIG. **4** is a side view showing this embodiment of the electronic equipment viewed from the left side. This embodiment of the electronic equipment uses an embodiment of the substrate according to the present

invention and an embodiment of the connecting structure according to the present invention. Further, in this embodiment, the present invention is applied to a lap-top personal computer.

As shown in FIG. **1**, the lap-top personal computer is generally made up of a main body **10** and a lid **11** having a display section **11**A. The display section **11**A is formed by a LCD panel, for example. The lid **11** has a structure capable of opening and closing with respect to the main body **10** via a hinge **12**. The main body **10** is assembled from a top cover **13** and a lower cover **14**. A keyboard **15** is provided on the top cover **13**. A battery **16** and a disk drive **17** for disks such as CDs and DVDs are mounted on the lower cover **14**.

A frame **18** and a main board (hereinafter simply referred to as a substrate) **19** which is fixed to the frame **18**, are provided within the main body **10**. Various electronic parts such as an IC chip, and various parts such as a heat sink **20** are provided on the substrate **19**. The electronic parts such as the IC chip are electrically connected via a printed wiring (electrical wiring pattern) on the substrate **19** and a FPC **21**. As will be described later, the electrical connection between the display section **11** A and the substrate **19** is made using a FPC **22**. One end of the FPC **22** is connected to the display section **11**A, and the other end of the FPC **22** is connected to a first connecting part **23** which is provided on a top surface of the substrate **19**. The first connecting part **23** electrically connects the other end of the FPC and one end of the FPC **21**. As will be described later, the other end of the FPC **22** is electrically connected to the electronic parts such as the IC chip on the substrate **19** via another connecting part and the printed wiring on the substrate **19**.

As shown in FIGS. **2** through **4**, a CPU **31**, an electronic circuit part **32** such as a power supply circuit, a PC card slot **33** and the like are provided on the top surface of the substrate **19**. A graphic LSI **34**, a second connecting part **43** and the like are provided on a bottom surface of the substrate **19**. The printed wirings (not shown) provided on the top and bottom surfaces of the substrate **19** and the FPC **21** electrically connect the electronic parts provided on the top and bottom surfaces of the substrate **19** and the connecting parts **23** and **43**.

In this embodiment, a cutout **19-1** is provided in the substrate **19** and the heat sink **20** is arranged within this cutout **19-1**, in order to efficiently radiate heat generated from the CPU **31**. For this reason, if the graphic LSI **34** which is to be connected to the display section **11**A were to be connected to the first connecting part **23** via the printed wiring on the top surface of the substrate **19**, the connection would have to be made by detouring around the heat sink **20**, the CPU **31** and the electronic circuit part **32**, and the degree of freedom of wiring would become small due to the restrictions with respect to the printed wiring. In addition, if the graphic LSI **34** were to be connected to the first connecting part **23** via the printed wiring on the bottom surface of the substrate **19**, the connection would have to be made by detouring around the parts such as the heat sink **20**, and the connection would also require a via hole or the like to connect the printed wirings on the top and bottom surfaces of the substrate **19**. Hence, the degree of freedom of wiring would also become small in this latter case due to the restrictions with respect to the printed wiring.

Hence, in this embodiment, the graphic LSI **34** and the display section **11**A are connected via the FPC **21** by connecting to the first connecting part **23**. The FPC **21** has an electrically insulated surface and a sufficiently compliant flexibility. Hence, the FPC **21** is bent freely from the top surface side to the bottom surface side of the substrate **19**, from the first connecting part **23** via the cutout **19-1**. In addition, the FPC **21** is connected to the graphic LSI **23** via the second connecting part **43** along the bottom surface of the heat sink **20**. As a result, the degree of freedom of wiring does not become small due to the restrictions with respect to the printing wiring on the substrate **19**. In addition, because the FPC **21** is thin, the thickness of the lap-top personal computer does not increase by the use of the FPC **21** for the connection. Furthermore, because the graphic LSI **34** on the substrate **19** is connected to the display section **11**A by the FPC **21** by connecting to the FPC **22** from the lid **11**, the wiring for connecting the graphic LSI **34** on the substrate **19** to the display section **11**A does not occupy the space on the substrate **19** for providing the various parts and the printed wiring, thereby enabling the size of the electronic equipment to the reduced.

In this embodiment the first connecting part **23** and the second connecting part **43** are provided at positions mutually deviated in the horizontal direction in FIG. **2**. Thus, the FPC **21** has a curved shape at an intermediate portion thereof as indicated by a dotted line in FIG. **2**. However, the FPC **21** may of course have a shape which extends linearly. In addition, although the FPC **21** is bent from the top surface side to the bottom surface side of the substrate **19**, the FPC **21** may exist only on the top or bottom surface of the substrate **19**.

Next, a description will be given of the conditions for not increasing the thickness of the lap-top personal computer even when the FPC is used, by referring to FIG. **5**. FIG. **5** is a diagram for explaining the positional relationships of the heights of the parts on the substrate **19** and a FPC **21-1**. In FIG. **5**, it is assumed for the sake of convenience that the FPC **21-1** has a shape which extends linearly, and that parts **51** through **54** respectively having heights h**1** through h**4** are provided on the substrate **19**, where h**1**>h**4**>h**3**>h**2**. The height h**4** of the part **54** is the highest, and determines the thickness of the lap-top personal computer. **W1** denotes a distance between the parts **51** and **54**, and **W2** denotes a width of the FPC **21-1**.

The parts **52** and **53** are arranged under the FPC **21-1**, and of these parts **52** and **53**, the height h**3** of the part **53** is the highest. The height h**4** of the part **54** is larger than a sum (h**5**+t) of a height h**5** and a thickness t of the FPC **21-1**. Accordingly, a relationship h**1**>h**4**>(h**5**+t) stands. In this case, if (h**1**−t)>h**3** and **W1**>**W2**, the use of the FPC **21-1** will not increase the thickness of the lap-top personal computer.

Next, a description will be given of the structure of the first connecting part **23**, by referring to FIGS. **6**A through **6**C and FIGS. **7**A and **7**B. FIGS. **6**A, **6**B and **6**C are diagrams showing the structure of the connecting part **23**. FIGS. **7**A and **7**B are diagrams for explaining a screw portion of the connecting part **23**.

FIG. **6**A shows a plan view of the first connecting part **23**, FIG. **6**B shows a side view of the connecting part **23** when viewed from the left side in FIG. **2**, and FIG. **6**C shows a side view of the connecting part **23** when viewed from the bottom side in FIG. **2**. As shown in FIGS. **6**A through **6**C, a top contacting part **221** is provided on the end portion of the FPC **22**. Two penetrating screw holes for receiving corresponding screws **230**, and a connecting portion **222** made up of a plurality of contacts are provided on the top contacting part **221**. The contacts of the connecting portion **222** are connected to corresponding lines of the FPC **22**. On the other hand, a bottom contacting part **211** is provided on the end portion of the FPC **21**. An inserting portion **211-10**

which can be inserted between two spacers **231**, and a connecting portion **212** made up of a plurality of contacts are provided on the bottom contacting part **211**. The contacts of the connecting portion **212** are connected to corresponding lines of the FPC **22**. As shown in FIGS. **6**A through **6**C, the contacts of the connecting portion **212** make contact with the corresponding contacts of the connecting portion **222** in a state where the contacting parts **211** and **221** of the FPCs **21** and **22** are connected.

FIG. **7**A shows a plan view of the spacer **231**, and FIG. **7**B shows a side view of the spacer **231**. As shown in FIGS. **7**A and **7**B, the spacer **231** has a flange **231-1** having a diameter ϕA, a groove **231-2**, and a flange **231-3** having a diameter ϕB. A screw thread **230-1** is provided within the spacer **231**, and the screw **230** can be tightened with respect to the spacer **231**. The FPCs **21** and **22** are connected by inserting the inserting portion **211-10** of the bottom contacting part **211** of the FPC **21** between the flanges **231-1** and **231-3** in a state where the contacting part **221** of the FPC **22** is provisionally connected to the flanges **231-1** of the spacers **231** by the screws **230**, and thereafter tightening the screws **230**.

By setting the diameters to satisfy ϕB>ϕA, it is possible to provisionally position the FPC **21** by inserting the inserting portion **211-10** of the bottom contacting part **211** of the FPC **21** into the groove **231-2**. In addition, when viewed from the top, the flange **231-3** is not hidden by the flange **231-1**, and thereby facilitating the operation of inserting the inserting portion **211-10** into the groove **231-2**. The flange **231-3** has a function of receiving the contacting part **211** of the FPC **21** when the connecting portions **212** and **222** of the FPCs **21** and **22** are connected. The flange **231-1** has a function of preventing the FPC **21** from being lifted up when disconnecting the FPCs **21** and **22**. When the spacer **231** has a height h**7** from the top surface of the substrate **19** to a lower surface of the flange **231-3**, it is possible to provide parts **55** having a height h**6** which satisfies a relationship h**7**>h**6** on the top surface of the substrate **19** in a vicinity of the connecting part **23** as shown in FIG. **6**B, by using the connecting structure described above. Hence, the area on the substrate **19** can be utilized efficiently.

In this embodiment, the top contacting part **221** of the FPC **22** is provisionally connected to the spacers **231** and the bottom contacting part **211** of the FPC **21** is inserted with respect to the contacting part **221**. However, it is of course possible to employ a structure such that the contacting part **211** of the FPC **21** is provisionally connected to the spacers **231** and the contacting part **221** of the FPC **22** is inserted with respect to the contacting part **211**.

In this embodiment, the connecting part **43** provided on the bottom surface of the substrate **19** is connected to the printed wiring which is formed on the bottom surface of the substrate **19** by a connecting structure similar to that used conventionally, without the use of the spacers **231**. More particularly, a contacting part having a structure similar to that of the top contacting part **221** of the FPC **22** and having a connecting portion is located on the end portion of the FPC **21** opposite to the end portion provided with the contacting part **211**, and this contacting part of the FPC **21** is secured on the substrate **19** by screws in a state where contacts of the connecting portion make contact with the corresponding printed wiring on the substrate **19**. However, if the FPC **21** is to be connected to another FPC at the second connecting part **43**, this connecting part **43** may employ the same connecting structure as the first connecting part **23**.

Next, a description will be given of various embodiments of the FPC, by referring to FIGS. **8** through **11**.

FIG. **8** is a diagram for explaining the first embodiment of the FPC. In FIG. **8**, contacting parts **211-1** and **211-2** having a plurality of contact, similarly to the contacting part **211** shown in FIGS. **6**A through **6**C, are provided on respective end portions of a FPC **21-2**. An intermediate portion of the FPC **21-2** is curved in a generally S-shape, so as to avoid the positions of the parts **51** and **54** provided on the substrate **19**.

FIG. **9** is a diagram for explaining the second embodiment of the FCP. In FIG. **9**, contacting parts **211-1** and **211-2** are provided on respective end portions of a FPC **21-3**. An intermediate portion of the FPC **21-3** is curved in a generally L-shape, so as to avoid the positions of the parts **51** and **54** provided on the substrate **19**.

FIG. **10** is a diagram for explaining the third embodiment of the FPC. In FIG. **10**, contacting parts **211-1** and **211-2** are provided on respective end portions of a FPC **21-4**. An intermediate portion of the FPC **21-4** is curved in a generally S-shape, so as to avoid the positions of the parts **51** and **54** provided on the substrate **19**. Furthermore, a contacting part **211-3** is provided at an intermediate portion of the FPC **21-4**. The contacting part **211-3** has a connecting portion with a plurality of contacts, similarly to the contacting part **211** shown in FIGS. **6**A through **6**C. The contacts of the connecting portion of the contacting part **211-3** may be connected to the printed wiring on the substrate **19**, similarly to the case of the connecting part **43**, for example, or connected to a connecting portion of another FPC, similarly to the case of the connecting part **23**. In this case, it is possible to make the wiring connections which are required at three locations on the substrate **19**.

FIG. **11** is a diagram for explaining the fourth embodiment of the FPC. In FIG. **11**, a FPC **21-5** has a shape which branches into three portions and avoids the positions of the parts **51** and **54** provided on the substrate **19**. Connector parts **211-1**, **211-2** and **211-4** are provided on the three end portions of the FPC **21-5**. Each of the contacting parts **211-1**, **211-2** and **211-4** has a connecting portion with a plurality of contacts, similarly to the contacting part **211** shown in FIGS. **6**A through **6**C. The contacts of the connecting portion of each of the contacting parts **211-1**, **211-2** and **211-4** may be connected to the printed wiring on the substrate **19**, similarly to the case of the second connecting part **43**, for example, or connected to a connecting portion of another FPC, similarly to the case of the first connecting part **23**. In this case, it is possible to make the wiring connections which are required at three locations on the substrate **19**.

In FIGS. **8** through **11**, the FPCs have shapes so as to avoid positions of the parts provided on the substrate. However, the FPC may pass above one ore more parts having a relatively low height. In addition, the shape of the FPC may of course be selected depending on the wiring length restrictions and to prevent mixture of external noise. Moreover, the FPC may of course have more than three contacting parts.

Next, a description will be given of the connection state of the FPC, by referring to FIGS. **12** and **13**. FIG. **12** is a diagram for explaining a connection state of the FPC, and FIG. **13** is a diagram for explaining another connection state of the FPC. FIGS. **12** and **13** show a case where one end of the FPC is connected to the top surface side of the substrate **19**, and the other end of the FPC is connected to the bottom surface side of the substrate **19**.

In FIG. **12**, one end of the FPC **21** is connected to the first connecting part **23** on the top surface side of the substrate **19**. The intermediate portion of the FPC **21** is bent towards the bottom surface side of the substrate **19** via an opening **19-2**

which is formed in the substrate **19**. In addition, the other end of the FPC **21** is connected to the second connecting part **43** on the bottom surface side of the substrate **19**. Hence, the FPC **21** may be freely arranged on both the top and bottom surface sides of the substrate **19** via the opening **19-2** in the substrate **19**.

In FIG. **13**, one end of the FPC **21** is connected to the first connecting part **23** on the top surface side of the substrate **19**. The intermediate portion of the FPC **21** is bent towards the bottom surface side of the substrate **19** along an edge **19-3** of the substrate **19**. In addition, the other end of the FPC **21** is connected to the second connecting part **43** on the bottom surface side of the substrate **19**. Accordingly, the FPC **21** may be freely arranged on both the top and bottom surface sides of the substrate **19**, without having to form an opening or a cutout in the substrate **19**, by bending the FPC **21** along the edge **19-3** of the substrate **19**.

In the embodiment of the electronic equipment described above, two FPCs **21** and **22** are provided with respect to the substrate **19**. However, the electrical connecting bodies are not limited to the FPC, and a wire harness may be used, for example. In other words, the electrical connecting body may be formed by various means other than the printed wiring (electrical wiring pattern) formed on the substrate **19**. In addition, the electrical connecting bodies such as the FPCs **21** and **22** simply need to electrically connect one portion on the substrate **19** and another portion, and one or three or more electrical connecting bodies may be used. In this case, the other portion to be connected to the one portion on the substrate **19** by the one or more electrical connecting bodies may be located on the substrate **19** or located outside the substrate **19**.

Therefore, the present invention is also applicable to the substrate **19** having no FPC **22** shown in FIG. **2**, for example. For example, in a case where no circuit wiring space is available on the right side of the CPU **31** shown in FIG. **2** on the top surface of the substrate **19**, the parts which need to be connected to the graphic LSI **34** must be arranged below the CPU **31**, for example, in FIG. **2** if the conventional technique is used. But according to the present invention, it is possible to make the necessary connection using the electrical connecting body such as the FPC. As a result, the present invention enables the parts which need to be connected to the graphic LSI **34** to also be arranged above the CPU **31** in FIG. **2**, thereby effectively utilizing the limited space on the substrate **19**.

The application of the present invention is of course not limited to the lap-top personal computer, and the present invention is similarly applicable to various electronic equipments such as information processing apparatuses and portable telephones which are made up of a main body and a lid which opens and closes with respect to the main body.

Further, the present invention is not limited to these embodiments, but various variations and modifications may be made without departing from the scope of the present invention.

I claim:

1. A connecting structure for connecting a first electrical connecting body and a second electrical connecting body, said first electrical connecting body having a first contacting part electrically connected to one or a plurality of electronic parts provided on a first surface of a substrate and a second contacting part, said second electrical connecting body having a first contacting part electrically connected externally to the substrate and a second contacting part, said connecting structure comprising:

a connecting part, provided on the substrate, electrically connecting the second contacting part of the first electrical connecting body and the second contacting part of the second electrical connecting body at a height position separated by a predetermined distance from the first surface of the substrate,

wherein said connecting part includes a spacer on which one of the second contacting part of the first electrical connecting body and the second contacting part of the second electrical connecting body is provisionally connected, said spacer being inserted with the other of the second contacting part of the first electrical connecting body and the second contacting part of the second electrical connecting body.

2. The connecting structure as claimed in claim **1**, wherein said first electrical connecting body has a portion extending along both the first surface of the substrate and a second surface of the substrate on an opposite side from the first surface.

3. The connecting structure as claimed in claim **1**, wherein said first electrical connecting body further has a third contacting part.

4. A connecting structure for connecting a first electrical connecting body and a second electrical connecting body, said first electrical connecting body having a first contacting part electrically connected to one or a plurality of electronic parts provided on a first surface of a substrate and a second contacting part, said second electrical connecting body having a first contacting part electrically connected externally to the substrate and a second contacting part, said connecting structure comprising:

a connecting part, provided on the substrate, electrically connecting the second contacting part of the first electrical connecting body and the second contacting part of the second electrical connecting body at a height position separated by a predetermined distance from the first surface of the substrate,

wherein the predetermined distance is set larger than a height of a highest part provided on the first surface of the substrate in a vicinity of said connecting part.

5. The connecting structure as claimed in claim **4**, wherein said first electrical connecting body has a portion extending along both the first surface of the substrate and a second surface of the substrate on an opposite side from the first surface.

6. The connecting structure as claimed in claim **4**, wherein said first electrical connecting body further has a third contacting part.

7. An electronic equipment comprising:

a main body internally having a substrate and a first electrical connecting body, said first electrical connecting body having a first contacting part electrically connected to one or more electronic parts provided on a first surface of the substrate and a second contacting part;

a lid which opens and closes with respect to the main body;

a second electrical connecting body electrically connecting the lid and the substrate, said second electrical connecting body having a first contacting part electrically connected to the lid and a second contacting part; and

a connecting part, provided on the substrate, electrically connecting the second contacting part of the first electrical connecting body and the second contacting part of the second electrical connecting body at a height

position separated by a predetermined distance from the first surface of the substrate.

8. The electronic equipment as claimed in claim **7**, wherein said connecting part includes a spacer on which one of the second contacting part of the first electrical connecting body and the second contacting part of the second electrical connecting body is provisionally connected, said spacer being inserted with the other of the second contacting part of the first electrical connecting body and the second contacting part of the second electrical connecting body.

9. The electronic equipment as claimed in claim **7**, wherein said first electrical connecting body has a portion extending along both the first surface of the substrate and a second surface of the substrate on an opposite side from the first surface.

10. The electronic equipment as claimed in claim **7**, wherein the predetermined distance is set larger than a height of a highest part provided on the first surface of the substrate in a vicinity of said connecting part.

11. The electronic equipment as claimed in claim **7**, wherein said first electrical connecting body further has a third contacting part.

12. The electronic equipment as claimed in claim **7**, wherein said first electrical connecting body extends over a part which is provided on the first surface of the substrate and has a height lower than a difference which is obtained by subtracting a thickness of said first electrical connecting body from a height of a highest part provided on the first surface of the substrate.

13. The electronic equipment as claimed in claim **7**, wherein said lid internally has a display section, one of the electronic parts provided on the substrate is a graphic LSI, and the first contacting part of the first electrical connecting body is electrically connected to the graphic LSI.

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